COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC UTILITIES

Petition of NSTAR Gas Company d/b/a Eversource Energy, pursuant to G.L. c. 164, § 94 and 220 CMR 5.00, for Approval of General Increases in Base Distribution Rates for Gas Service.	)	D.P.U. 19-120

INITIAL BRIEF OF HOME ENERGY EFFICIENCY TEAM, INC.

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Introduction

Home Energy Efficiency Team, Inc. ("HEET"), a Massachusetts nonprofit organization, appreciates the opportunity to file this initial brief concerning the Petition of NSTAR Gas Company d/b/a Eversource Energy ("Eversource" or the "Company") for approval by the Department of Public Utilities (the "Department") of an increase in base distribution rates and performance-based regulatory plan for gas service.

HEET will be substantially, specifically and uniquely affected by this proceeding in terms of the proposed geothermal pilots (the "Geothermal Projects" or "Projects," each a "Geothermal Project" or "Project") intended to test the viability of networked geothermal as a business model for local distribution companies ("LDCs"). HEET created, and is inextricably connected with, the concept, known as GeoMicroDistricts, that leads to the design of the Geothermal Projects.

HEET urges the Department to approve the Company's Geothermal Projects because they can offer multiple benefits to the Company's ratepayers including increased safety and reliability. Additionally, the information learned from them can advance the Commonwealth's emissions reduction policies and increase the speed of electrification, while providing equitable access to renewable heat for all customers. The potential benefits described, weighed with the known risks, including economic and environmental, make the investment in this pilot proposal reasonable and necessary.

I. Description of HEET

HEET is a mission-oriented nonprofit organization seeking to cut carbon emissions now by driving systems change and is the unique originator of the GeoMicroDistrict concept (the "GeoMicroDistrict") upon which the Company's Geothermal Projects are based. Indeed, the President of the Company, William Akley, in testimony to the Telecommunications,

Utilities, and Energy Joint Committee at the Massachusetts Statehouse, stated that "the insights to this came from our engagement with HEET and Buro Happold's work." Natural Gas Hearing of the Joint Committee on Telecommunications, Utilities and Energy, 2019 Leg., 191st Sess. (Mass. 2019). In line with its mission to drive systems change, HEET believes the potential of the GeoMicroDistrict to cut carbon emissions is so large, it has spent close to half of its staff time for three years developing, researching, refining and sharing the GeoMicroDistrict.

II. Procedural History

On November 8, 2019, the Company, under G.L. c. 164 § 94, filed a petition with the Department for a general increase in gas base distribution rates, and it was docketed as D.P.U. 19-120. Among the many components of the petition, Eversource requested an increase in rates designed to collect $38.03 million in additional revenue through base distribution rates, and submitted a proposal to implement a performance-based ratemaking ("PBR") mechanism that would allow the Company to adjust its distribution rates on an annual basis through the application of a revenue-cap formula and to put in place a set of metrics to evaluate the Company's performance. The Company's proposed PBR plan includes two demonstration projects: (1) a gas demand response project; and (2) the Geothermal Projects.

Under G.L. c. 12, § 11E(a), on November 12, 2019, the Attorney General of the Commonwealth of Massachusetts (the "Attorney General") filed a notice of intervention. Additionally, on November 13, 2019, under G.L. c. 12 § 11E(b), the Attorney General filed a notice of her intent to retain experts and consultants in order to fully represent the interests of customers of the Commonwealth. HEET moved to intervene on December 26, 2019 and was admitted as a limited intervenor in this proceeding to intervene with respect to the geothermal

network demonstration project. As of December 27, 2019, the Department approved the status of the following entities as participants, intervenors, or limited intervenors in this proceeding: the Department of Energy Resources ("DOER"), Low-Income Weatherization and Fuel Assistance Program Network, the Energy Network, Direct Energy, HEET, Power Options, the United States Department of Defense, United Steelworkers of America, and the Berkshire Gas Company. On April 2, 2020, the Department issued a procedural schedule that allowed for filing of intervenor testimony, discovery, and evidentiary hearings. Evidentiary hearings in this proceeding commenced on June 16, 2020 and concluded on July 1, 2020.

III. Standard of Review

A. Prudence of Rate Increase

Under G.L. c. 164, § 94, the Department must review the propriety of general rate case increases and determine whether a rate increase is just and reasonable. Attorney General v. Department of Telecommunications and Energy, 438 Mass. 256, 264 n.13 (2002); The Berkshire Gas Company, D.P.U. 96-67, at 6 (1996). Moreover, "[f]or costs to be included in a company's rate base, the expenditures must be prudently incurred, and the resulting plant must be used and useful in providing service to ratepayers." Western Massachusetts Electric Company, D.P.U. 85-270, at 20 (1986). The prudence test determines whether cost recovery is allowed at all, while the used and useful analysis determines the portion of prudently incurred costs on which the utility is entitled to earn a return. D.P.U. 85-270, at 20, 25-27.

A prudence review involves a determination of whether the utility's actions, based on all that the utility knew or should have known at that time, were reasonable and prudent in light of the extant circumstances. Such a determination may not properly be made on the basis of hindsight judgments, nor is it appropriate for the Department merely to substitute its own

judgment for the judgments made by the management of the utility. Attorney General v. Department of Public Utilities, 390 Mass. 208, 229 (1983). A prudence review must be based on how a reasonable company would have responded to the particular circumstances and whether the company's actions were in fact prudent in light of all circumstances that were known or reasonably should have been known at the time a decision was made. Boston Gas Company, D.P.U. 93-60, at 24-25 (2003); D.P.U. 85-270, at 22-23; Boston Edison Company, D.P.U. 906, at 165 (1982). A review of the prudence of a company's actions is not dependent upon whether budget estimates later proved to be accurate, but rather upon whether the assumptions made were reasonable, given the facts that were known or that should have been known at the time. Massachusetts-American Water Company, D.P.U. 95-118, at 39-40 (1996); D.P.U. 93-60, at 35; Fitchburg Gas and Electric Light Company, D.P.U. 84-145-A, at 26 (1985).

The Company bears the burden of demonstrating the propriety of additions to rate base through clear and cohesive reviewable evidence on rate base additions. Massachusetts Electric Company, D.P.U. 95-40, at 7 (1995); D.P.U. 93-60, at 26; The Berkshire Gas Company, D.P.U. 92-210, at 24 (1993); Massachusetts Electric Company v. Department of Public Utilities, 376 Mass. 294, 304 (1978); Metropolitan District Commission v. Department of Public Utilities, 352 Mass. 18, 24 (1967). Additionally, the type of project documentation required can vary depending on the type of project but, at a minimum, rate base additions must be supported by documentation that allows the Department to evaluate the prudency of each of the capital projects, and to make a determination that each project was placed in service during the test year and is used and useful. Bay State Gas Company, D.P.U. 13-75, at 105 (2014). Post-test-year adjustments to rate base are allowed for investments under certain circumstances. Western Massachusetts Electric Company, D.P.U. 85-270, at 62-63, 140-141 (1986). A post-test year

addition to plant must be known and measurable, as well as in service. Dedham Water Company, D.P.U. 84-32, at 17 (1984); D.P.U. 906, at 7-11.

B. Demonstration Projects

In evaluating a company's proposed demonstration project, the Department considers the following factors: (1) the consistency of the proposed demonstration program with applicable laws, policies, and precedent; (2) the reasonableness of the size, scope, and scale of the proposed projects in relation to the likely benefits to be achieved; (3) the adequacy of the proposed performance metrics and evaluation plans; and (4) bill impacts to customers. See NSTAR Electric Company and Western Massachusetts Electric Company, D.P.U. 16-178, at 16 (2016); NSTAR Electric Company d/b/a Eversource Energy, D.P.U. 17-05, at 234 (2017); Fitchburg Gas and Electric Light Company, D.P.U. 16-184, at 11 (2017). Although the Department does not require a demonstration project to be cost-effective, the addition of a demonstration project must not result in a sector's benefit-cost ratio falling below one. Investigation by the Department of Public Utilities on its own Motion into Updating its Energy Efficiency Guidelines Consistent with An Act Relative to Green Communities, D.P.U. 08-50-B, at 49 (2008). In the absence of cost-effectiveness screenings, the Department requires detailed program descriptions and appropriate analyses to support the potential of the proposals to deliver net benefits in the future. D.P.U. 16-178, at 30; D.P.U. 16-184, at 11. Finally, the Department will examine the bill impacts that customers would experience as a result of the demonstration project to assess the reasonableness of the associated costs to an affected customer class. G.L. c. 25 § 21(d)(2).

IV. The Department Should Approve Eversource's Geothermal Projects.

HEET, as previously noted, is the unique originator of the GeoMicroDistrict and intervened for the purpose of seeking to shepherd its inclusion, and assurance that it will be a rigorous and well-executed demonstration project with transparency and stakeholder processes guaranteed (including the intent to benefit ratepayers and the public) in the Department's final order.

Seeking an alternative to gas infrastructure replacement that could move Massachusetts (or any other state) along a productive path to meetings its climate goals, HEET created the concept of LDCs replacing strategic street segments of leak-prone gas infrastructure with street segments of networked geothermal infrastructure, allowing an LDC to provide renewable thermal energy delivered via water in pipes. Over time, as more GeoMicroDistricts are installed, they could interconnect to create utility scale renewable thermal energy systems, or a thermal grid ("GeoGrid").". To research the potential of the GeoMicroDistrict to meet buildings' heating and cooling needs in Massachusetts, HEET raised funds for a statewide feasibility study. The HEET-Buro Happold Feasibility Study (the "Feasibility Study") demonstrated that GeoMicroDistrict infrastructure could meet 100% of the heating and cooling needs of buildings in a significant portion of individual street segments in the existing Massachusetts gas system. See D.P.U. 19-120, DPU-ES-9-23(a). The potential is high for interconnection of these segments to increase the extent of service territory the system can provide. In addition to improving safety, health, and resilience, a GeoMicroDistrict installed today in Massachusetts, would reduce emissions by 60% or more for the buildings connected to it, since the only emitting energy used would be the electricity used to operate the necessary water pumps and heat pumps. Id. at 5. As the electric grid shifts

to using more renewable energy, the GeoMicroDistrict's emissions would drop further. If by 2050 the Commonwealth meets the current mandated emissions targets, the emissions attributed to the GeoMicroDistrict would be reduced by 90% from current levels. Id. at 49. Finally, recently amended targets established by the Governor[1] would result in an even lower GHG footprint than the 90% reduction calculated in the Feasibility Study.

The Geothermal Projects therefore have the potential to be an integral part of the emissions reductions required by state law. Their design is reasonable in size, scope, and scale to enable appropriate data collection to assess the expected benefits and the possibility of expansion and replication. While there is a short-term cost to ratepayers, the Department must also weigh those against not only the long term savings to ratepayers posited by the Geothermal Projects, but also the long terms costs of business as usual. In addition, HEET proposes to enhance the evaluation and stakeholder processes to the benefit of the Company, stakeholders, and the Department. HEET believes that all of these factors taken together weigh in favor of the Department approving the Geothermal Projects.

A. The Department Should Approve the Geothermal Projects Because They Are Consistent with the Laws, Policies, and Precedents of the Commonwealth.

1. The Commonwealth's Emissions Mandates Will Require Deployment of Diverse Technologies to Achieve the Required Results and the Geothermal Projects Have Enormous Potential, Once Tested, To Be a Necessary Part of the Solution.

The Department should approve the Company's proposed Geothermal Projects because they will meaningfully advance the Commonwealth's urgent mandates for decarbonization and

[1] *See* COMMONWEALTH OF MASS., EXEC. OFFICE OF ENERGY AND ENVTL. AFFAIRS, DETERMINATION OF STATEWIDE EMISSIONS LIMITS FOR 2050 (2020), https://www.mass.gov/doc/final-signed-letter-of-determination-for-2050-emissions-limit/download.

greenhouse gas ("GHG") emissions reduction. In making this determination, the Department's review should include whether a company's proposal contributes to state requirements for reducing greenhouse gas emissions, and the impacts of state policies and regulations on utility capital assets. In 2008, Massachusetts passed the Global Warming Solutions Act ("GWSA"), making it one of the first states in the nation to implement a comprehensive regulatory program to address climate change. St. 2008, Chapter 298, codified in relevant part at G.L. c. 21N and G.L. c. 30, § 61. The GWSA requires the state to reduce its emissions by at least 80 percent below statewide 1990 GHG emission levels by 2050. Id. Additionally, the GWSA requires that coordinated efforts be made by state agencies to achieve these aggressive GHG emissions limits. Id. In order to achieve the necessary emissions reductions, the state is required to set mandatory intermediate targets for the state, including a 2030 target, which will likely be a reduction of 35 to 50 percent.[2]

In 2016, the Supreme Judicial Court unanimously ruled that the state must enforce these GWSA reduction mandates. See Kain v. Department of Environmental Protection, 474 Mass. 278 (2016). In Kain, the Supreme Judicial Court held that the GWSA requires the Department of Environmental Protection to set actual limits on emissions rather than aspirational goals stating that "[i]t is doubtful that the Legislature would require the promulgation of regulations had it only meant for the [D]epartment to set aspirational targets, and if that was its intention, it could have used the word 'target' or 'goal'." Id. at 288. The Supreme Judicial Court concluded by stating that "the purpose of [the GWSA] is to attain actual, measurable, and permanent emissions reductions in the Commonwealth, and the Legislature included § 3(*d*) in the statute to ensure that legally mandated reductions are realized[.]" Id. at 300. Similarly, in 2018, the Supreme Judicial

[2] *See Resolution Concerning Climate Change*, COALITION OF NORTHEASTERN GOVERNORS (Aug. 31, 2015), https://www.coneg.org/wp-content/uploads/transferred/Data/Sites/1/media/39-1-climate-change.pdf.

Court again stated, "the act is designed to make Massachusetts a national, and even international, leader in the efforts to reduce the greenhouse gas emissions that cause climate change" and "[i]t thus establishes significant, 'ambitious,' legally binding, short- and long-term restrictions on those emissions." New England Power Generators Association v. Department of Environmental Protection, 480 Mass. 398, 399 (2018). The court also noted that while "[t]he long-term goal of the act is to ensure that the Commonwealth meets the 2050 Statewide emission limit…to set the Commonwealth on a course to meet this limit, the year 2020, as the first and nearest short-term goal, is of special importance." Id. at 411.

In addition to the GWSA and Supreme Judicial Court decisions, on September 16, 2016 Governor Baker signed Executive Order 569, setting forth a comprehensive approach to meeting the Commonwealth's GHG emission goals. This Executive Order specifically highlights the need for collaboration stating "only through an integrated strategy bringing together all parts of state and local government will [we] be able to address these threats effectively." Executive Order No. 569: Establishing an Integrated Climate Change Strategy for the Commonwealth (Sept. 16, 2016). Moreover, in January 2020, Governor Baker, during his annual State of the Commonwealth address, announced a new commitment to achieve net-zero GHG emissions by 2050 so that Massachusetts can "take more decisive action" on climate change.[3]

As part of its implementation of the GWSA emissions reductions, the Commonwealth has developed a "road map" initiative[4] to identify all viable pathways to achieve not only the 80 percent reduction by 2050 but also net zero. After the Governor announced the intent to

[3] *Governor Baker Delivers 2020 State of the Commonwealth Address*, COMMONWEALTH OF MASS. (Jan. 21, 2020) https://www.mass.gov/news/governor-baker-delivers-2020-state-of-the-commonwealth-address.
[4] *MA Decarbonization Roadmap*, COMMONWEALTH OF MASS., www.mass.gov/2050roadmap (last visited July 22, 2020).

pursue the more aggressive net zero goal by 2050, the Secretary of Energy and Environmental Affairs signed a "letter of determination" stating that the new 2050 target would be net zero, but in any event not less than an 85 percent reduction in greenhouse gases.[5]

While the Commonwealth has achieved some improvements in the reduction of GHG emissions particularly in the energy sector with leadership on energy efficiency and installation of renewable energy resources, immediate additional actions, including the accelerated development of renewable energy, are required in order for the Commonwealth to be on a trajectory to meet its 2050 mandates. As electrification and decarbonization of the heating sector increases, the Commonwealth's declining fossil fuel demand will have a profound impact on gas distribution system management, operations, and rates, thus requiring LDCs to make substantial changes to their planning processes and business models. Despite the Commonwealth's emission mandates and these projections on how to meet them, LDCs are continuing to invest ratepayer funds in the replacement of a quarter of the aging gas pipes under our streets.[6] These new pipes will last for decades past 2050, when, given the emission reduction mandates, it is unlikely natural gas will be widely used in its current form. Eversource itself acknowledged that in order for Massachusetts to meet its targets, the Company must explore ways to "decarbonize energy resources with the ultimate goal of delivering a clean energy future." D.P.U. 19-120, ES-WJA/DPH-1, at 65.

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[5] *See* COMMONWEALTH OF MASS., EXEC. OFFICE OF ENERGY AND ENVTL. AFFAIRS, DETERMINATION OF STATEWIDE EMISSIONS LIMITS FOR 2050 (2020), https://www.mass.gov/doc/final-signed-letter-of-determination-for-2050-emissions-limit/download.

[6] *See* APPLIED ECON. CLINIC, PLANNING FOR THE FUTURE: MASSACHUSETTS CLEANS UP ITS HEATING 1 (2020), https://static1.squarespace.com/static/5936d98f6a4963bcd1ed94d3/t/5eea18d1be9fa7700896f97a/1592400083010/Planning+for+the+Future_AEC+Brief_17Jun2020.pdf (A June 2020 policy brief found that the total cost of the new gas infrastructure (installed between 2015 and 2040 as part of the Gas System Enhancement Plan (GSEP), with the cost of capital and a 2% annual escalation in price), will be over $17 billion. At the current rate of charge ($5/month), rate payers will be paying back this infrastructure until 2122.).

The Department has a significant role in the transition away from the Commonwealth's reliance on natural gas and other fossil fuels. Geothermal networks, such as the Geothermal Projects, have the potential to be an indispensable resource to meaningfully reduce GHG. In fact, the Company has reviewed estimates that the technology deployed in the Geothermal Projects can reduce carbon emissions by up to 60 percent for an average residential customer. D.P.U. 19-120, ES-PMC/MRG-1, at 46. Because the primary objectives of the Company's proposed Geothermal Projects are to "test the viability of [the Geothermal Projects as a] business model, assess the enabling technology, and evaluate costs and benefits;" and those benefits include significant and necessary contributions to the reduction of GHG emissions required by state law, the Department should find that the Geothermal Projects are consistent with the Commonwealth's law, policies, and objectives. Id. at 25.

2. The Geothermal Projects Are Consistent With, and Further Eversource's Emissions Goals as Detailed in, its Sustainability Plan.

As previously stated, in order for the Commonwealth to meet its emissions mandates, the state needs to significantly decrease its reliance on combustion of fossil fuels, particularly in the thermal sector. Eversource has recognized that the provision of natural gas for heat cannot persist at current levels and therefore has made public its own emission goals and plans for cleaner, lower–emitting options. Since 2013, the Company reports a continuous reduction of its emissions and is a committed industry leader in implementing strategies to transition away from and decrease fossil fuel consumption in the Commonwealth.[7] Indeed, the Company has a target of being carbon neutral by 2030, the only U.S. energy utility with such an ambitious goal.[8]

[7] *See* EVERSOURCE ENERGY, 2018 SUSTAINABILITY REPORT (2018), https://www.eversource.com/content/docs/default-source/community/sustainability-report-full-2018.pdf.
[8] *See* EVERSOURCE ENERGY, 2019 ANNUAL REPORT 2 (2020) https://www.eversource.com/content/docs/default-source/Investors/annual-report.pdf.

Eversource currently aims to meet its energy goals by: (1) reducing its own energy use (and incorporating renewable energy into its own facilities), (2) reducing sulfur hexafluoride use in electrical gas-insulated switchgear, (3) upgrading its natural gas distribution system to improve safety and eliminate methane leaks, (4) promoting customer energy efficiency programs, and (5) increasing investments in renewable generation.[9] Eversource was, in 2018, recognized as the number one energy efficiency provider in the nation, and, in 2019, Eversource received the ENERGY STAR Partner of the Year from the U.S. Environmental Protection Agency and the U.S. Department of Energy for continued leadership in energy efficiency.[10] The Company has acknowledged "it is imperative that it work together with regulators, customers, and other interested stakeholders to explore cost-effective and innovative solutions as the Commonwealth seeks to reduce greenhouse gas emissions." D.P.U. 19-120, ES-WJA/PMC/MRG-Rebuttal-1, at 34. The Geothermal Projects are a product of this growing commitment to emissions reductions by the Company and piloting this concept reflects not only its demonstrated capacity for emission reduction leadership but also will move the Commonwealth forward "on clean energy innovation" and lead to the development of cleaner options for its customers. D.P.U. 19-120, ES-PMC/MRG-1, at 25. Thus, the Department should approve the Geothermal Projects so that the Company can generate vital experience and knowledge in the short term to inform long term discussions on the potential of geothermal network service to meet the goals and needs of the Commonwealth. Eversource has not only demonstrated leadership in its commitment to reducing emissions and offering cleaner options to its customers, but also well-reasoned strategic approach on how to obtain these goals. One of these strategies is to pilot the Geothermal Projects to learn how they might transform LDC thermal delivery model with a

[9] *See* EVERSOURCE ENERGY, *supra* note 7, at 6.
[10] *Id.*

cleaner, lower-emitting options. HEET believes that the Department should approve the Geothermal Projects because Eversource has demonstrated a reasoned, prudent approach in their development and proposed execution.

3. The Geothermal Projects Will Build on Known, Quantifiable Benefits from Prior Installations of Geothermal Loops for the Purpose of Studying the Feasibility of Delivering Substantial Savings to Customers Through a Novel LDC Managed Model.

In D.P.U. 17-05, NSTAR Electric Company d/b/a/ Eversource Energy proposed to pilot an energy storage demonstration project, which was designed to help foster the market for energy storage in the Commonwealth. D.P.U. 17-05, at 455 (2017). In that proceeding, the Department did not deny the Company's proposal just because benefits might be given to stakeholders other than the Company or its customers. See id. at 470.

Although there are no known installations exactly like the proposed Geothermal Projects, there are systems on college campuses (such as at Colorado Mesa and Weber State Universities) that are similar enough that those outcomes are instructive with respect to this proposal. See D.P.U. 19-120, Exh. HEET-4. While these systems are not owned by an LDC and do not have boreholes in the street, they do have many buildings with diverse types of energy use connected to one shared loop of ambient-temperature water, which is connected to several borehole fields for thermal energy management and storage.

For 40% of the year the Colorado Mesa system remains in the design temperature window without need for the borehole fields or the backup energy sources to adjust the loop temperature. See id. What this means is that the different buildings connected to the shared loop at Colorado Mesa have sufficiently different or mixed energy use that buildings calling for heat and buildings calling for cooling balance each other's demand. Cooling towers typically use 20–

50% of a facility's total water use in institutional and commercial buildings. Id. at 1. In the Colorado Mesa case, since cooling is primarily delivered through the more efficient ground source heat pumps, the water use per person was cut by two thirds. Id. at 4. In addition to the reduction in water use, this shift off cooling towers contributed to a reduction in peak electric need. The square footage of the buildings heated and cooled by the system increased by 50% between 2013 and 2015, yet the electric load has mostly stabilized between three and four megawatts. Id. Being able to deliver a radical reduction in onsite emissions without increased electric load would represent the type of systemic innovation that HEET is committed to and that is necessary for achieving emissions reductions and combating climate change. Scaled up, this type of system could allow building electrification without as much electric grid infrastructure investment as other pathways to electrification. The Colorado Mesa University shared-loop geothermal system also cuts total energy use by 75% and energy bills by 60% when compared, on a per square foot basis, to a conventional combination of natural gas boilers and cooling towers. Id.

There is substantial evidence, of which this is just one example, that the utilization of geothermal technology presents opportunities for significant savings in electric (peak), thermal, and water use. These known benefits pose little risk to ratepayers that some benefits will not be realized by deployment of the Geothermal Projects. Eversource proposes to build off this knowledge base by expanding the technology's reach to even more diverse loads across its customer base, which will actually increase efficiency of the system, while utilizing the Company's LDC experience to manage the loads. The known benefits combined with the opportunity to learn more about greater savings in a utility administered model, benefitting multiple customers, weigh in favor of approving the Geothermal Projects.

B. The Department Should Approve the Geothermal Projects Because They Are Reasonable in Size, Scope, and Scale in Relationship to Benefits.

Eversource has proposed a carefully crafted approach in the Geothermal Projects to test the viability and scalability of geothermal network distribution service and to share that knowledge with the Department and stakeholders. The Company has explained that the three proposed Projects were each chosen because they are "representative of the types of scenarios that the Company is likely to face if geothermal distribution service is offered at scale and they represent the different types of service environments present across the Company's service territory." D.P.U. 19-120, ES-WJA/PMC/MRG-Rebuttal-1, at 34, n.4.

The Geothermal Projects are reasonable in terms of the relationship of size, scope and scale to their benefits unique to each Project site. The high density Project is the most expensive and ambitious, with approximately 100 units, both residential and commercial, to be connected to the shared loop. However, it also offers by far the most benefits in terms of energy savings and information. The Feasibility Study found that high density street segments have, on average, an almost equal need for heating and cooling, and thus are easiest to thermally balance. See D.P.U. 19-120, DPU-ES-9-23(a), at 28. Because of the ease of thermal balancing, it is easiest to start in a high density site and grow out from there into lower density areas. The density of energy savings, per linear foot of the shared loop installed, is the highest. As this Project is the most interesting and potentially rewarding, the HEET Research Team (defined below) has submitted an application to U.S. Department of Energy ("DOE") specifically for this Project. The low-density residential street-segment Project with approximately 10 homes was put forth by Eversource with the stated aim of learning about the difficulty of installing boreholes in the street. A low density site, with less underground infrastructure, is ideal for this objective. And the low-income multi-unit Project was designed by Eversource with the aim of learning if

enough boreholes for the energy needs can be installed within the property line or under the building. Although both of these Projects would offer these data, HEET believes there is also an opportunity for more data with the addition of one or more non-residential customers. If mixed-energy use customers could be added sequentially after the residential ones, the resulting data could quantify efficiencies resulting from mixed energy use.

As noted previously in this proceeding, the Geothermal Projects are rooted in the proven technology of Fifth Generation (5G) District Heating and Cooling Systems, one of the most efficient types of thermal energy systems in the world and one of the least expensive methods of reducing emissions. See D.P.U. 19-120, Exh. HEET-2. One primary advantage of these low or ambient-temperature water-based thermal systems is the potential for energy sharing or load cancelling among customers. Another advantage is the capacity to centrally manage and maintain the system, thus allowing for optimization and equitable energy access. The Geothermal Projects as proposed will adapt this existing technology with the following innovations: (1) geothermal boreholes primarily in the right of way of the street; (2) utility ownership and management for diverse customers; and (3) design for thermal balance rather than for peak load, reducing the linear feet of boreholes necessary per building and thus reducing the cost of the installation and the provided energy.

While there have been many individual geothermal systems and some networked geothermal systems installed, the Geothermal Projects proposed advance the base principles of the 5G technology to this new level. In order to test the concept's viability, to learn more about the costs and savings, and to prove customer acceptance, it is necessary to pilot the concept in the Commonwealth with a utility-owned demonstration project.

Rather than serving a single, large customer or district, the proposed Geothermal Projects serve a street segment,[11] pumping thermal energy in a closed loop in that street and supplying thermal energy, through service lines, to the customer buildings on that street. Thermal energy pumped up and down the street in the shared loop is delivered via ambient-temperature water. The ambient temperature allows the system to provide both heating and cooling via a single pipe, further allowing for load cancelling and a reduction of infrastructure cost. Because the temperature is maintained within a design window of roughly between 40 and 80 degrees Fahrenheit and optimized to remain in "balance" as close to ambient ground temperature as possible, thermal energy losses to the surrounding ground are minimized. Finally, HEET recommends the use of pure water (rather than adding chemicals such as glycol) to reduce any potential environmental impact from leaks and reduce cost significantly.

Each connected customer building contains a heat pump replacing the pre-existing furnace or boiler. The heat pump removes, from the shared loop of water, as much temperature (either heating or cooling) as the building demands. The water then returns to the loop at an incrementally lower or higher temperature than is initially supplied. The temperature removed from the supply loop is then circulated inside the building through the building's HVAC distribution system, whether forced air or forced water.

This shared loop is filled only once, with the water recirculated through the system, meaning that the need for fresh water is minimal. If it does leak at any point, unlike gas, there is no danger of an explosion. Fixing leaks on the shared loop of water would be similar in costs

[11] The only Eversource suggested Geothermal Project that is not a street-segment pilot is the multi-unit low-income building pilot. HEET suggests this pilot include at least one additional customer (to ensure it is a pilot appropriate to a utility to install) and that the customers added represent a mixed energy use. HEET further suggests that sequencing the addition of the added customer/s could provide valuable data for optimization.

and use similar materials, techniques and tools to that of leaks on a natural gas pipe (although these pipes are both safer and easier to pressure test since there would be no explosive gas). Identified leaks can be repaired using butt or socket fusion most commonly, and electrofusion on larger pipe diameters. Engineers, general contractors and laborers experienced with natural gas service networks will be prepared for the assembly and repair of shared water loops. Leaks in a borehole and other components of closed loop systems are rare when following established industry standards for assembly and pressure testing.

Some customers, such as supermarkets, data centers, and larger offices require cooling even during the winter. Thus, they will return the water into the shared loop hotter, warming the water for homes demanding heat down the street. Such wasted thermal energy can also be stored until needed in the ground via the borehole array (borehole thermal energy storage). See D.P.U. 19-120, Exh. HEET-5. The ground is the cheapest and largest capacity long-term energy storage known. Id. When needed, the managing utility can ensure the system remains within the optimal temperature range using a backup heater and cooler connected to the shared loop. Thus each Geothermal Project delivers thermal energy to its customers from three sources: (1) what would otherwise be wasted energy, recaptured and delivered to the customer; (2) the energy stored by the geothermal borehole arrays; and (3) when needed, through a backup heater and/or cooler.

The infrastructure, including the shared loop and the borehole array, can be installed, wherever feasible, in the Company's right of way in the street. The boreholes are drilled at what is considered a shallow depth, generally not exceeding 500 feet depth. At this depth, the boreholes are designed to cyclically store temperature in the bedrock and retrieve it when needed (they do not extract the higher temperature of the Earth's core). Massachusetts geological data

shows that the majority of the state, with the notable exception of Cape Cod, has an appropriate bedrock depth and type for this borehole storage. See D.P.U. 19-120, DPU-ES-9-23(a), at 12-13.

The Geothermal Projects will allow the Company, and its workers, to test a transition path to a new business model capable of meeting the requirements of the state-mandated lower-emitting future. One of the possible opportunities for expansion is, where strategically feasible, sections of aging leak-prone gas infrastructure can be "pruned" and replaced with GeoMicroDistricts. Strategic selection of such segments could provide multiple possible benefits to the existing gas customers and gas system, such as cost avoidance and capacity constraint reduction. The system could also be installed on streets with delivered fuels to expand the customer base without an increase of gas pipeline supply. Beyond the benefits of cost-avoidance and capacity constraint reduction, there is the anticipated benefit of both substantial greenhouse gas reduction and increased safety.

The second innovation that is possible should the outcomes of the pilot indicate as such, is the GeoGrid. As previously described, any GeoMicroDistrict, after installation and commissioning, can be interconnected like Lego® blocks, with other GeoMicroDistricts, gradually growing into a utility-scale grid. This results in an energy delivery system that is both interconnected and independent, providing both the optimization and efficiency of a centralized system and the resilience of a decentralized system in a novel hybrid design. As the system gets larger, there will be more and more customers with diverse energy needs, allowing more energy to be used that would have otherwise been wasted. In this way, the system can achieve increasing levels of efficiency as it grows, while simultaneously decreasing energy costs for customers. Also, the GeoGrid growth model allows for incremental reduction of gas use while maintaining reliability and continued provision of

thermal energy to LDC customers. Furthermore, as the GeoGrid grows, its long term energy storage capacity increases. This increases the utility companies' thermal management choices, with one example being the ability to use wind energy at non-peak times to raise or lower the temperature in the shared loop and in the borehole arrays, to meet later demand during peak hours.

Under this GeoGrid vision, the Company's role switches from distributing an explosive fossil fuel to managing the thermal balance of this clean energy system to keep the temperature in the shared loop in its 40 to 80 Fahrenheit ideal temperature range. In Massachusetts, a region climate that currently uses more heating than cooling, individuals' installations are at risk of building up excess cold over time. Rather than let this cold gradually move the system out of its preferred temperature range, in a utility-managed system the cold could be supplied to different customers who require it throughout the year such as hockey rinks and refrigerated warehouses. Many managements exist, including for example, the use of excess cooling capacity to restore river waters to their pre-climate-change temperatures. As the Massachusetts climate shifts, so can the many possible thermal management strategies.

Most ground source heat pumps for single buildings are installed to supply enough heat for the peak demand hour of the year. This means that single-building installations are oversized for the vast majority of the year. The Geothermal Projects (and ultimately the GeoGrid) are instead designed for thermal balance (*i.e.*, to optimize the amount of time the shared loop of water can be kept within the desired temperature range without need for backup heating or cooling). By designing the system for thermal balance, rather than for peak load, the installed system and its attached boreholes can be smaller and less expensive per building, while the lifetime of the attached heat pumps can be extended. Since ground source heat pumps are twice

as efficient as air source heat pumps, they would require only half of the required increased electric capacity, especially during temperature extremes when air source heat pumps would be least effective.

The Geothermal Projects can also increase resilience in at least three different ways. First, since the infrastructure delivering the thermal energy is underground, it is less susceptible to extreme weather events. Second, resilience can potentially be increased through adding electric batteries to each street segment, providing backup power to both water pumps and the heat pumps in the building, allowing the thermal energy to be delivered even if the electric grid goes down, thus creating islands of heating and cooling during power outages. Third, it would offer customers a choice between thermal energy delivered by pipes or by wires, making sure that we are not all dependent on only one energy delivery system.

The Geothermal Projects propose to collect data to demonstrate that deploying heat pumps over the shared loop increases their overall efficiency and effectiveness with the long-term result of reducing electric load. The proposed Geothermal Projects will provide the data needed, from a range of different customer scenarios, to make informed decisions on investment of ratepayer funds. Given the potential benefits and savings described for participants, for Eversource ratepayers and for the Commonwealth, together with the need for more data and a consideration of the risks of not acting, HEET believes that approval of the Geothermal Projects is reasonable in size, scale, scope.

C. Specific, Consistent Metrics for Data Capture With a Diverse Informed Research Team Would Ensure the Necessary Transparency of Data and Results to Facilitate Replication of the Geothermal Projects, and That Utilizing a Community Charrette Process to Facilitate the Exchange of Information Between All Stakeholders, Including In Site Selection, Would Ensure a Robust Pilot Program.

HEET is fully committed to ensuring that Eversource's Geothermal Projects have the best chance of success, and believes that key components of such success is transparent and accountable data collection and analysis and a robust, diverse stakeholder process.

To ensure the aims of transparency, learning and knowledge dissemination are met, as part of its application to the DOE's Geothermal Technologies Office Hydrothermal and Low Temperature Multi-Topic Funding Opportunity, HEET assembled a research team. Included in the HEET Research Team are researchers and analysts from Lawrence Berkeley National Laboratories (LBNL), University of California Berkeley (UCBerkeley), Harvard University's T.H.Chan School of Public Health, U.S. National Renewable Energy Laboratories (NREL), MIT Sloan School, and Buro Happold Engineering (the "HEET Research Team)". See D.P.U. 19-120, Exh. HEET-1. This team demonstrates the level of national interest in the feasibility of deploying the innovative technology proposed by Eversource to achieve systemic solutions for emissions reduction.

This HEET Research Team can enhance and extend the proposed Geothermal Projects. The DOE grant application is focused on the high density pilot site as the most impactful of the Geothermal Projects although the work of the HEET Research Team can inform the other projects as well. The HEET Research Team has committed to build a full model of the proposed Geothermal Project, before installation, to support design optimization efforts and further ensure success. This model would include the hydrogeology of the Project site and its ongoing impact on ground heat transfer for the borehole thermal energy storage array, the ground loop temperature variation and pumping powers and speeds, the customer buildings with their weatherization and thermal efficiency, HVAC efficiency and ongoing thermal demand, the heat pump sizing and efficiency at varying temperature loop feeds, and the electric

system's demand over the course of a range of weather scenarios. This model would then be improved through data collection during and after installation of the Geothermal Project, creating a more realistic and useful model for ongoing optimization and management of the installed system by the Company. This model could then be used in the design and optimization of future installations. The standardized data structure will allow for meaningful comparison across installations.

The HEET Research Team, working with Eversource, will design a standard set of metrics for data collection from this new type of infrastructure, as well as a standard recommended evaluation protocol to be used in commissioning and testing of the Geothermal Projects. These standards will allow comparison across future installations, thus enhancing learning. Finally, the models will be used to project system scale impacts in order to inform all of potential challenges and benefits to scaling this infrastructure, including impacts on health and safety, electric grid load profiles, and the economy.

DOE requires full data transparency and the HEET Research Team has committed to publish all data objects from the study to the DOE Geothermal Project Repository,[12] which will be maintained in perpetuity. Therefore, all data objects, including the models developed and the outcomes and results of the analyses will be public and accessible. If the HEET Research Team is partially or fully funded by DOE, or similar funding entity, HEET believes that the work of the HEET Research Team should be an integral part of the Geothermal Projects and greatly appreciates Eversource's letter of support and participation with the submission to DOE. Furthermore, regardless of funding status for the research team, HEET proposes that the

[12] *See* U.S. DEP'T OF ENERGY, GEOTHERMAL DATA REPOSITORY, https://gdr.openei.org/ (last visited July 23, 2020).

Department adopt the DOE data sharing and transparency guidelines for the Geothermal Projects.

As previously noted, HEET has a unique interest in the piloting of the Geothermal Projects, having commissioned the Feasibility Study for the GeoMicroDistrict that informed the Projects' design. See D.P.U. 19-120, DPU-ES-9-23(a). HEET's mission to work towards systemic innovation to reduce emissions is intrinsically linked to ensuring that these pilot projects are adequately executed with appropriate monitoring, data collection and analysis, and ongoing stakeholder education and engagement. HEET intervened in these proceedings to bring its research, expertise, network of experts, and other stakeholders to help ensure that the Geothermal Projects accurately assess their potential to reduce the state's emissions, to improve public safety and health, and to ultimately reduce costs to ratepayers.

HEET developed the GeoMicroDistrict in an ongoing stakeholder engagement process across diverse sectors, including LDC executives[13] and workers, training centers, climate scientists, geothermal installers and scientists, community organizers, state agency representatives, activists, legislators, architects and more. This engagement process began in 2018 and the most recent charrette[14] was hosted at MIT in January of 2020.[15] Participants in these gatherings are continuing to engage (albeit virtually and with less baked goods for the foreseeable future) with the GeoMicroDistrict concept through this charrette model ("Community Charette"), and their diverse expertise and viewpoints represent a significant resource.

[13] Eversource is a participant.
[14] In this context, "charrette" means a community meeting in which stakeholders are informed of project status and attempt to assess projects, resolve challenges, and suggest solutions for the future, thus becoming co-creators of the outcomes.
[15] *See HEET Runs Utility-Scale Geothermal Charrette in MIT's January Session*, HEET, https://heetma.org/2020/02/05/heet-runs-utility-scale-geothermal-charrette-in-mits-january-session/ (last visited July 23, 2020).

HEET has diligently worked to create this stakeholder group for this specific technology, and intends to continue this existing, independently funded Community Charrette process. HEET believes that the regular (quarterly) continuation of these Community Charrettes, will be of ongoing benefit to the Company's proposed Geothermal Projects. Should the Company wish to merge its intended stakeholder engagement with HEET's Community Charrette process, HEET will gladly work with the Company to adapt the process, for example, to include site-specific stakeholders.

HEET believes the integration of the HEET Research Team, the DOE transparency guidelines, and the Community Charrette process will connect considerable intellectual, experiential, and community resources to the Geothermal Projects proposed and promote a positive, streamlined process through transparency and engagement. HEET believes the Company and the Geothermal Projects will benefit from the additional information and resources provided, maximizing the chance of success and minimizing the risks. Given HEET's commitment to those outcomes, it asks the Department to consider the availability of these resources in its review and deliberations.

D. The Department Should Approve the Geothermal Projects Because the Opportunity to Demonstrate the Long-Term Energy and Cost Savings for Customers Outweighs Any Short-Term Bill Impacts.

The point of any pilot program is to test the proposed concept for the desired results and the potential for replication. The LDCs are currently replacing leak-prone gas pipes across the Commonwealth with potentially stranded fossil fuel assets totaling billions of dollars.[16] Knowing what alternatives to pipeline replacement exist earlier rather than later would result in

[16] *See supra* note 6 and accompanying text.

more informed decision-making and long term cost savings. The Company proposed the Geothermal Projects to determine if there is a cleaner, lower-emitting, lower cost option for its customers. The cost of the Geothermal Projects is far less than 1% of the total GSEP cost calculated to be over $17 billion[17] with $416 million spent on replacing 280 miles of gas mains statewide in 2017. Report to the Legislature on the Prevalence of Natural Gas Leaks in the Natural Gas System, D.P.U. 19-GLR-01, at 16 (2019). Every year that these pilots are delayed, hundreds of millions of additional ratepayer dollars are further invested in the replacement of what will potentially be stranded fossil fuel infrastructure.

The Geothermal Projects are a potential method to avoid investing in replacement natural gas infrastructure, which can turn into stranded assets. These benefits accrue not only to Eversource ratepayers, but to all residents of the Commonwealth through their deployment and the possibility of future expansion. In terms of monetary savings, one of the main reasons for the Geothermal Projects is the need to quantify actual costs and savings. While there are many benefits ranging from air quality, public safety, increased resilience, and reduced electric peaks, there is an urgent need to collect data to find ways to quantify the potential monetary savings from the Projects, which are believed to include: (1) EPA approved values for the social costs of carbon dioxide and methane (unburned natural gas is overwhelmingly methane);[18] (2) the avoided costs of natural gas fuel constraints during peak hours;[19] (3) reduced potential for

[17] *Id.*
[18] *See The Social Cost of Carbon*, U.S. ENVTL. PROT. AGENCY, https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html (last visited July 23, 2020) (The EPA values the social costs of carbon dioxide (CO2) at $42 per metric ton for 2020 in the United States.).
[19] *See* SYNAPSE ENERGY ECON., INC., AVOIDED ENERGY SUPPLY COMPONENTS IN NEW ENGLAND: 2018 REPORT (2018), https://www.synapse-energy.com/sites/default/files/AESC-2018-17-080-Oct-ReRelease.pdf (The report found that the avoided costs of fuel constraints of natural gas use through efficiency for all residential uses (non-heating, hot water, heating) in Southern New England was $7.65/MMBtu.).

explosions and fires (as we have seen all too much of with the Columbia Gas disaster);[20] (4) reducing the statewide expense of repairing potentially hazardous gas leaks;[21] (5) reductions in emergency room visits and deaths through air pollution[22] (where the treatment, emergency care, hospitalizations and deaths disproportionately affect low income communities of color);[23] (6) reduction in needed upgrades to the electric grid; (7) the increased resilience and storage of such a system; and finally, (8) potential significant customer energy bill savings, as demonstrated at sites like Colorado Mesa University.

The collection of data from the Geothermal Projects will enable a better understanding of the full range of benefits and savings and costs associated with deployment of this technology. Approving these three Projects which are in reasonable in scale, size, and scope is a prudent investment by the Company to obtain data that can be used to realize cleaner, less expensive, and more efficient outcomes for its customers, and potentially all customers.

1. The Company Should Consider Reducing the Cost and Number of Backup Heaters and Coolers by Utilizing a Single Backup System on the Shared Loop, Rather Than One In Each Customer Unit.

Eversource's suggested design for the Geothermal Projects include a separate heater and cooler in each residential or commercial unit, in every building attached to the networked

[20] *See* Lisa Kashinsky, *Columbia Gas Parent Company Says Cost for Merrimack Valley Gas Disaster Could Hit $1B*, BOSTON HERALD (May 1, 2019, 8:36 P.M.), https://web.archive.org/web/20190502151443/https:/www.bostonherald.com/2019/05/01/nisource-ups-cost-estimates-for-merrimack-valley-gas-disaster/.

[21] *See* D.P.U. 19-SQ-09. Eversource's 2018 Annual Service Quality Report lists 1,177 Grade 1 and 2 leaks as being repaired. At an average gas leak repair cost of $3,500, the estimated cost would be $4 million.

[22] *See* Jos Lelieveld, *Loss of Life Expectancy From Air Pollution Compared to Other Risk Factors: A Worldwide Perspective*, OXFORD UNIVERSITY PRESS (Mar. 3, 2020), https://doi.org/10.1093/cvr/cvaa025 (The study finds that air pollution of all kinds, not just natural gas, kills more people than HIV/AIDS, parasitic, vector-borne, and other infectious diseases combined.).

[23] *See generally* Robert D. Bullard, *Environmental Justice For All*, NAT'L HUMANITIES CTR. (last visited July 24, 2020), http://nationalhumanitiescenter.org/tserve/nattrans/ntuseland/essays/envjust.htm.

geothermal systems, to serve as a backup system. Since the Geothermal Projects will be connected to approximately 140 different units), approximately 140 heaters and coolers would need to be purchased and installed, increasing the overall cost of the projects, and taking up space in each unit. D.P.U. 19-120, ES-PMC/MRG-3 at 3. HEET therefore suggests that the simplest and less expensive method may be a single heater and cooler on the shared loop of water to ensure the temperature of the water is kept in the needed temperature range and ensure all connected units have sufficient access to thermal energy from the shared loop. The shared loop heater and cooler could be located in a similar way to the water pumps in a mechanical room in or near the street along the shared loop, either in an aboveground structure or in a sunken box under the sidewalk (similar to gas metering and regulatory stations already located throughout the gas distribution system). An additional benefit of this shared loop heater and cooler is that it ensures that the water in the shared loop can be maintained in the design temperature range of 40 to 80 degrees Fahrenheit even in extreme circumstances. This means the system would not need glycol to ensure the water would not freeze. Removing the need for glycol through a different design would result in potential savings, with the total high-cost scenario potentially totaling up to $319,866. D.P.U. 19-120, DPU-ES-20-9 and DPU-ES-20-17-RV-01. HEET suggests that these design changes could have systemic benefits and savings that would only improve the Geothermal Projects as envisioned by Eversource.

V. Conclusion

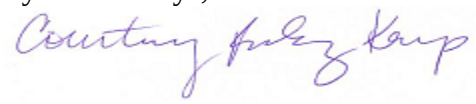
If successfully executed, the Geothermal Projects can potentially offer not just Eversource, but also other Massachusetts LDCs, and even those across the country, a new business model for a lower emissions future, allowing gas workers to transition with minimal retraining and reducing the amount of newly installed gas infrastructure that future

generations will have to pay for. The Geothermal Projects offer multiple benefits to Eversource ratepayers and others, including safety, increased reliability, and potential reduction in cost. They can also help the Commonwealth meet its emissions targets while increasing the speed of electrification and providing equitable access to renewable heat across the customer base regardless of existing pipeline infrastructure. The potential benefits described, weighed with the known risks, both economic and environmental, make the moderate investment in this pilot proposal reasonable and necessary. This innovative proposal is, in the midst of the climate crisis, one possible path forward to a better future. HEET appreciates Eversource for taking the step of proposing the Geothermal Projects to seek solutions to meet the needs and protect the well-being of its customers into the future. For the reasons stated above, HEET respectfully requests that the Department approve the Geothermal Projects.

Respectfully Submitted,

The Home Energy Efficiency Team, Inc. (HEET)

By its attorneys,



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DATED: July 24, 2020

CERTIFICATE OF SERVICE

I certify that I have this day served the foregoing document on all parties of record in the above-captioned proceeding in accordance with the requirements of 220 C.M.R. § 1.05.

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Courtney Feeley Karp

DATED: July 24, 2020